

# Supplementary Motor Area: A view from the left hand of the grip force modulation in unimanual and bimanual symmetric task.

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## Introduction :

- ❖ The grip force modulation (GFM) in relation to the linguistic stimulation has been correlated to the semantic decoding (Frak, Nazir, Goyette, Cohen, & Jeannerod, 2010) and the somatotopic representation of the words (Hauk, Johnsrude, & Pulvermüller, 2004).
- ❖ A network composed of the intraparietal area, Brodmann area 6, the Broca area and M1, in conjunction with their roles, have been discussed for their effect on the GFM of the right hand (RH) (Ramayya, Glasser, & Rilling, 2010; Stout & Chaminade, 2012; Tomasino & Rumiati, 2014).
- ❖ The Brodmann area 6 included the premotor area (PMA) and supplementary motor area (SMA). Both have been associated to planification of action (Pilgramm et al., 2016), and SMA is particularly active during bimanual mouvements (Naito, Morita, & Amemiya, 2016).
- ❖ The aim of this study is to provide a description of the GFM of the left hand (LH) between unimanual and bimanual grip. Compare it to the RH in both conditions in order to add some evidence for understanding the linguistic function processing in both hemispheres.

## Method :

### Experiment 1 : Unimanual group.

- ❖ Participants
  - ◆ 14 right-handed Canadians high school students (14-17 years old).
  - ◆ Their maternal language is French.
- ❖ Stimuli
  - ◆ 35 words related to semantic hand action and 35 words not related to hand actions. The words are in the French language.
  - ◆ The words listed to are recorded individually and listened to randomly. The recording lasts 1 minute and 15 seconds.
  - ◆ In each block, the same word is repeated between 10 to 12 times. The repeated word is the target word.
  - ◆ Half of the block is a target action and the other half is a non-action word.
- ❖ Equipment and data acquisition
  - ◆ A uniaxial grip force sensor weighing 55g, with a diameter of 5 cm and 1, 8 cm in large. Each grip force sensor is connected to an amplificator Honeywell DV10L
  - ◆ Data acquisition card : Measurement computing series 1608G.
  - ◆ Headphone and a sound console Eurorack MX802A
  - ◆ The GFM is recorded online at 1Khz and extracted on the software dasylab.
- ❖ Procedure
  - ◆ The participant listened to 8 blocks of stimuli. Half of the blocks were completed with the sensor in the right hand, and the half with the sensor in the left hand.
  - ◆ During each block, participants' eyes were closed.
  - ◆ The order of the hand and target word category was randomly presented for each participant.
  - ◆ The participant had to count the target word to verify their attention.
  - ◆ The grip force sensor was held in a tridigital grip (thumb, index, middle).
- ❖ Data analysis
  - ◆ For each target stimulus, an epoch of -300 msec and 1000 msec at the begging of the stimuli were extracted.
  - ◆ Each epoch was normalized to the participant's baseline (-200 msec to 0 msec)
  - ◆ Where the GFM exceeded +/- 200 mN or presented a modulation over 100 mN inside 100 msec was rejected (Nazir et al., 2015)
  - ◆ A participant with less than 75% of data after rejection was excluded.
  - ◆ An outlier test was performed (the modified Thompson Tau) due to the population size.
  - ◆ This project is about the role of different motor areas in the action linguistic network, thus only the data relating to the action word is analyzed.
  - ◆ In each condition and for each participant, the average was used to observe comparisons to the baseline and ANOVA to observe the differences in their hands.

### Experiment 2 : Bimanual group.

- ❖ Participants
  - ◆ 45 right-handed Brazilian students (14-17 years old).
  - ◆ Their maternal language is Portuguese.
- ❖ Stimuli
  - ◆ Idem to experiment 1, except the words were in Brazilian Portuguese
- ❖ Equipment and data acquisition
  - ◆ Idem to experiment 1.
- ❖ Procedure
  - ◆ The participant listened to 2 blocks of stimuli holding a grip force sensors in each hand.
  - ◆ The other part of the procedure was identical to the experiment 1.
- ❖ Data analysis
  - ◆ Idem to experiment 1.
  - ◆ Except, no outlier test was needed due to the population size.

## Results :

Experiment 1: Unimanual grip	
Anova Results	P<0.01, F(2.082, 35.402)=10.494
Mauchly sphericity test	$\chi^2(90)=433.805$ , p<0.001
Sphericity Corretion	Greenhouse-Geisser: $\epsilon = 0.16$
Hand with the strongest modulation	
Right hand	P<0.05 de 500 à 650 Msec
Superior to the baseline	
Right hand	P<0.05 de 300 à 800 Msec
Left hand	P<0.05 de 650 à 750 Msec

Experiment 2: Bimanual grip	
Anova Results	P>0.05, F(2.341, 88.953)=1.314
Mauchly sphericity test	$\chi^2(90)=661.693$ , p<0.001
Sphericity Correction	Greenhouse-Geisser: $\epsilon = 0.18$
Hand with the strongest modulation	
N/A	
Superior to the baseline	
Right hand	P<0.05 de 250 à 800 Msec
Left hand	P<0.05 de 300 à 800 Msec



## Conclusion:

- ❖ In the unimanual task, a difference between the GFM, between the hands and comparisons to the baseline show a different profile than the pretty identical curve of the GFM in bimanual.
- ❖ At the beginning of the augmentation, we can see in the distance between the curve of the GMF in the unimanual condition disappear in bimanual condition.
- ❖ These results can be explained by SMA which has shown to be more active in bimanual movements (Naito et al., 2016).
- ❖ The inclusion of SMA in the action semantic network appears to be act as a facilitator in the network with the intraparietal area, Broca's area and M1.

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